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AUTHOR Diggles, Virginia A.
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ABSTRACT

An experiment to determine the effects of perceptual organization on learning and remembering a motor task is described. Four test groups received different methods of presentation of movements to be learned--sequential-sequential, sequential-random, random-sequential, and random-random. Analysis of variance was used to examine results. Results presented support of the hypothesis that perceptual organization on learning a motor task is beneficial. No evidence was found to support any beneficial effect of perceptual organization on retention of motor information over a period of time. (JD)

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Virginia A. Diggles
Univ. of Wisconsin
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Benefits of Organization on Learning and Retention

Recently, organizational processes in memory have seen renewed interest from the motoric area of behavior research. Historically organization received extensive investigative attention in the areas of perception and verbal memory. In a shift away from associationistic psychology, Gestalt psychologists advanced the notions of perceptual organization and grouping. Wertheimer's organizing principles of proximity, similarity, closure and prägnanz are to be found in most any perception text. Verbal learning research has produced several paradigms (serial, paired associate, and free recall) for studying the effects of organization on the recall of lists. The serial and paired associate paradigms traditionally imposed organization on both the input and output, while measuring the accuracy of the output - a procedure which restricts the cognitive involvement of the subject in organizing the input and limits the findings to memory search and retrieval. This method of structuring the input to examine the output is termed Experimenter presented organization. In the free recall paradigm, the input is random and the output is examined for some organizing principle (clustering, chunking, etc.). Thus any organization present in the information output must have been imposed by the subject. Subject discovered organization, as this has been termed, provides insight into the structuring principles individuals use to transform information. The research reviewed and presented here utilized experimenter presented organization, and as such concerns the organization of input information, which has been termed perceptual organization.

In the motor domain, our history has somewhat paralleled that of the verbal learning theorists. That is to say until recently our models of memory have been representative of associationistic principles. The concept of "traces" in memory whose strength develop as a function of practice is certainly reminiscent of the S-R approach. The problems of limited storage and novel situations have cropped

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up to detract from "trace" models of memory. Schmidt (1975) and Pew (1974) have postulated that rather than passively recording and storing an individual "trace" of motor information, we actively organize and abstract incoming information. Now, in the verbal literature information input in a meaningful or organized way has been found to facilitate retention. A similar prediction in motor memory could not be made since organization should have no effect if the "trace" strength is determined by repetition and feedback. However, should experimenter-presented organization facilitate motor performance, we would have evidence mediating against an S-R view of motor memory.

Such facilitation has been demonstrated in the motor area. Nacson, Jaeger and Gentile (1972), Nacson (1973), and Diewert and Stelmach (1978) have all studied the effects of different orders (constant, random, sequential) of presentation on the reproduction accuracy for movement. I would like to briefly review the pertinent findings of one experiment from the Diewert and Stelmach study prior to presenting the current research, since their procedures were similar and prompted the current design. Diewert and Stelmach tested the reproduction of 5 movement lengths on a linear slide. A set of 5 movements constituted one trial; the order of presentation of these 5 movements determined the experimenter-presented organization: in a sequential presentation subjects were presented with the shortest criterion distance first and required to reproduce it, followed by the next longest distance and so on; in the random presentation, each trial order was a random permutation of the five movements. Testing proceeded in two phases: the learning phase consisted of ten trials with knowledge of results; and the withdrawal phase consisted of six trials without knowledge of results. The combination of two orders of presentation and two phases yielded four experimental groups: sequential-sequential, sequential-random, random-sequential, random-random. Thus half the subjects learned under sequential presentation and half under a random presentation in Phase I. In Phase II, half of the sequential learners switched to the random order while the other half remained

in a sequential condition. The original random group was split in the same fashion. In all groups, subjects were periodically reminded to attend to the order of presentation. In the learning phase, the Groups, Movements, and Trials effects in absolute error were significant with the sequential groups outperforming the random group. In the withdrawal phase, the Groups, Movements, Groups X Movements, and Groups X Trials interactions were significant. Descriptively, the groups who had learned under a sequential presentation (sequential-sequential and sequential-random) remained at lower error levels than the group who had learned under a random presentation (random-sequential and random-random). Diewert and Stelmach concluded that movement components learned in an organized setting continued to exhibit organizational benefits even when performed in a random order. Summarily, perceptual organization was claimed to be a potent variable in motor learning.

The purpose of the present study was four-fold:

1. To reconfirm the efficacious nature of perceptual organization on motor learning and retention.
2. To examine the interaction of organization and knowledge of results.
3. To test the notion that perceptual organization may enhance retention over time.
4. To re-examine the generalizeability of organized learning to random conditions.

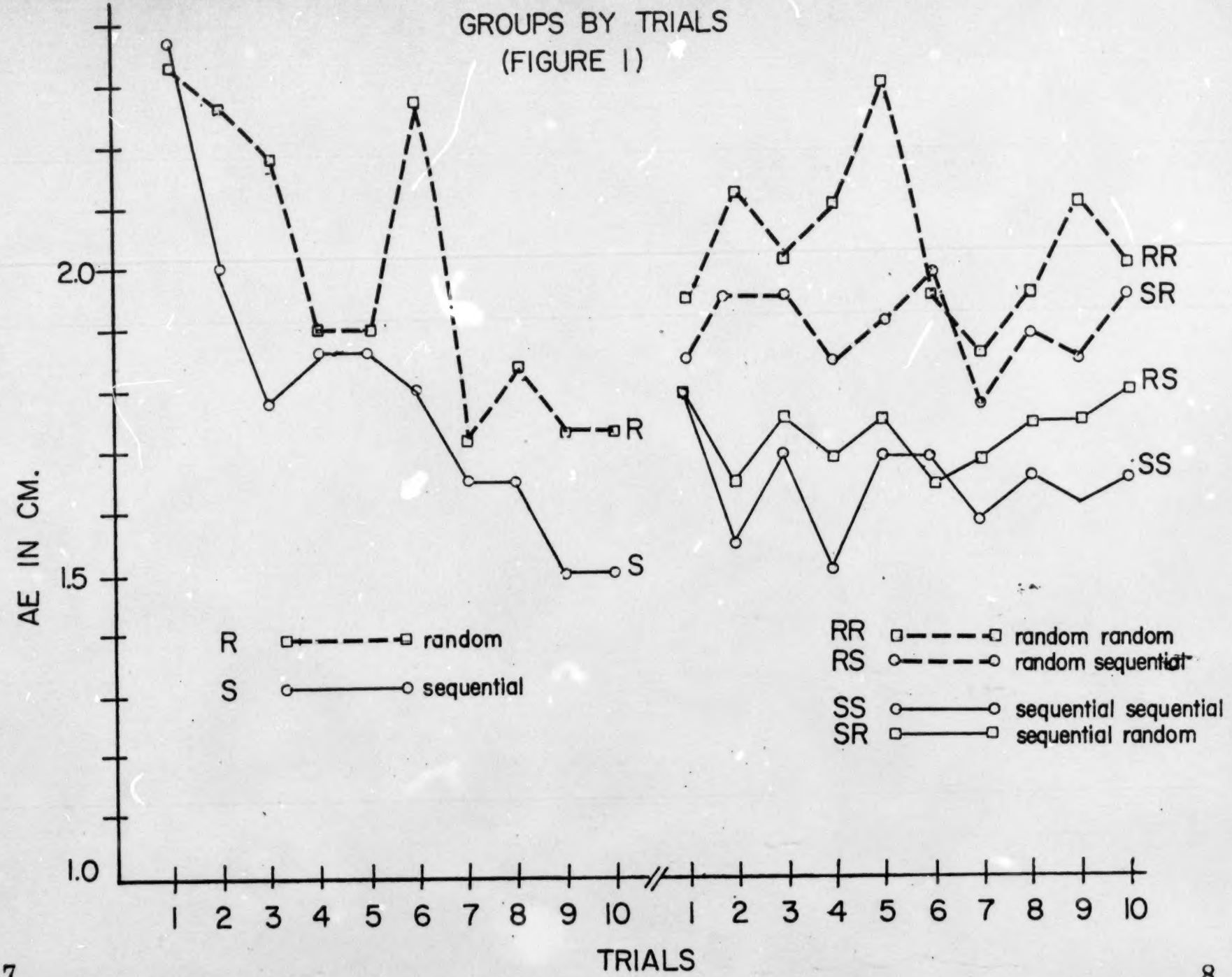
The same reproduction paradigm was used here as previously described. 120 male and female subjects were randomly assigned to one of four experimental groups. The groups were defined by the four combinations of sequential and random presentations on two phases of performance as before. Crossed with these groups were the presence or absence of knowledge of results during Phase 1 (learning) and the retention interval between phases (0, 2, or 4 days). No one received knowledge of results in Phase II. Subjects were nested within the Groups X KR X Retention Interval combination. Each subject performed ten trials per phase; with each trial consisting of the prescribed order (random or sequential) of five movements, either 10, 20, 30, 40 or 50 cm.

Analysis of variance was used to examine absolute error scores with α set at .05. In Phase 1, the Groups, Knowledge of results, Trials, and Movement effects were significant. In Phase II, the Groups and Movement effects were significant. (Slide #1) Now Figure 1 displays the Grous X Trials interaction for both phases. In Phase 1, the sequential group performed with less error than the random group, although the rate of learning was unaffected by organization as evidenced by the lack of a significant interaction here. In Phase II, note that the groups performing under sequential order are superior to those performing under a random order. This finding only partially replicated that of Diewert and Stelmach. Here the determining factor for the groups with mixed training regimens is the order they are currently performing under and not the order under which they learned. Although both Diewert and Stelmach's finding and the present finding argue against encoding specificity, they do not support the same interpretation of the facilitating effect of organization to motor memory. The present results seem to indicate that organization is a potent variable only at the time of reproduction and does not appear to transfer to other contexts. If such is the case, organization appears to be useful only as a retrieval aid. The lack of an effect of retention interval seems to support this idea that perceptual organization does not benefit storage or retention. (Slide 2) The next slide shows the groups X Retention Interval interaction. Note the trend of superior performance of the random-sequential group relative to the sequential0random group and the lack of consistent retention interval effects.

The potential benefit of externally presented organization to learning is clearer when comparing the effects of knowledge of results and organization. The presentation of knowledge of results in the learning phase was a significant effect but did not carry over to the withdrawal phase. (Slide #3) The next slide shows the Groups X KR interaction for both phases. Note first the trend of Groups similar to the previous slides. Note next the practical equivalence of the sequential NO KR group to the Random KR group. It appears that a sequential presentation can

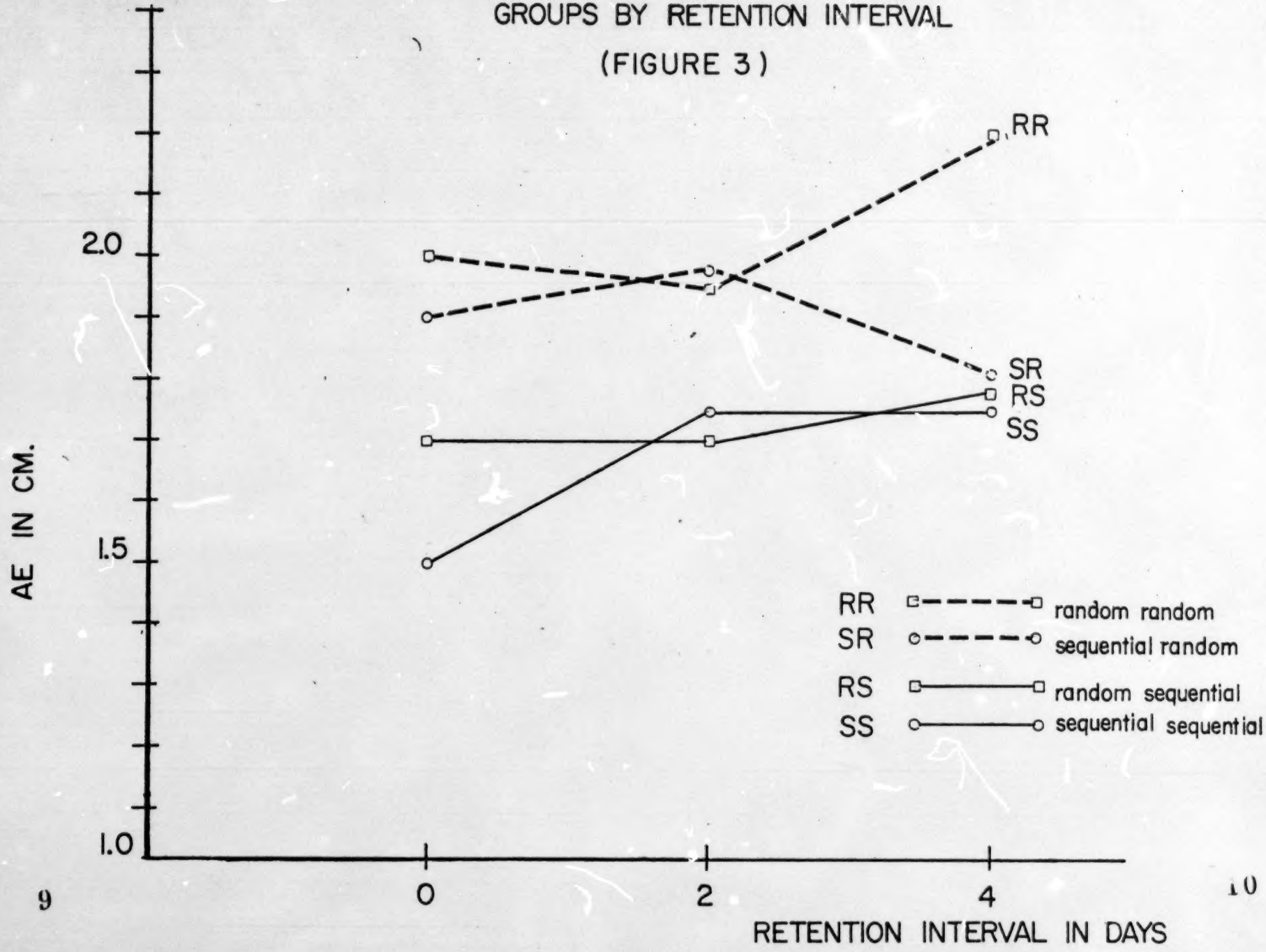
attenuate the deficit in performance that usually occurs when Knowledge of results is not provided. Such a finding is strong support for the benefits of organization on learning.

In summary, the results presented support the beneficial effects of perceptual organization on learning a motor task, to the extent that performance is better and knowledge of results is not necessary. No evidence was found to support any beneficial effect of perceptual organization on retention of motor information over time, although I feel a different design could test this notion better. Finally, no evidence was found to support the generalizeability of organized learning to random conditions.


GROUPS BY TRIALS
(FIGURE 1)
AE IN CM.
2.0
1.5
1.0
R
S
RR
SR
RS
SS
R random
S sequential
RR random random
RS random sequential
SS sequential sequential
SR sequential random
1 2 3 4 5 6 7 8 9 10
1 2 3 4 5 6 7 8 9 10
TRIALS

GROUPS BY RETENTION INTERVAL

(FIGURE 3)



GROUPS BY KR CONDITION
(FIGURE 2)